

APPENDIX E: MULTI-TX AND ANTENNA SAR CONSIDERATIONS

E.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D04v01 are applicable to devices with built-in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit with the licensed transmitter

E.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D04v01 and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1g SAR for all the simultaneous transmitting antennas in a specific physical test configuration is ≤ 1.6 W/kg. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1g or 10g SAR.

E.3 Exposure Ratios

Exposure ratio (ER) for different transmitters is calculated as following:

$$ER_{SAR,n} = \frac{SAR_n}{SAR_{limit}}$$

Where:

- SAR_n is the SAR value for the n -th transmitter/test frequency
- SAR_{limit} is the basic restriction limit that is applicable to the n -th transmitter/test frequency

Compliance with the SAR-PD-UWB based RF exposure limits is achieved if $TER_{SAR} \leq 1$. When $TER_{SAR} > 1$, SPLSR is additionally evaluated per below equation:

$$SPLSR = \frac{(ER_j + ER_k)^{1.5}}{R}$$

Where:

- ER_j and ER_k are exposure ratio of transmitter j and k
- R is the distance between transmitter j and k

When SPLSR is ≤ 0.02 for 1g exposure conditions or SPLSR is ≤ 0.013 for 10g exposure conditions simultaneous SAR evaluation is not required.

FCC ID A3LSMX730	RF EXPOSURE TEST REPORT	Approved by: Technical Manager
DUT Type: Portable Computing Device		APPENDIX E: Page 1 of 3

E.4 Tablet SAR Analysis

Table E-1
Simultaneous Transmission Scenarios for WLAN/BT

Configuration	2.4 GHz WLAN Ant WiFi 0 Ratio to Limit	2.4 GHz WLAN Ant WiFi 0 at 11.5 dBm Case Ratio to Limit	2.4 GHz WLAN Ant WiFi 1 Ratio to Limit	2.4 GHz WLAN Ant WiFi 1 at 11.5 dBm Case Ratio to Limit	2.4 GHz WLAN Ant WiFi 1 Worst Case Ratio to Limit	2.4 GHz WLAN MIMO Ratio to Limit	2.4 GHz WLAN MIMO at 14.5 dBm Case Ratio to Limit	5 GHz WLAN Ant WiFi 0 Ratio to Limit	5 GHz WLAN Ant WiFi 0 at 7 dBm Case Ratio to Limit	5 GHz WLAN Ant WiFi 0 Worst Case Ratio to Limit	5 GHz WLAN Ant WiFi 1 Ratio to Limit	5 GHz WLAN Ant WiFi 1 at 7 dBm Case Ratio to Limit	5 GHz WLAN Ant WiFi 1 Worst Case Ratio to Limit	5 GHz WLAN MIMO Ratio to Limit	5 GHz WLAN MIMO at 10 dBm Case Ratio to Limit	5 GHz WLAN MIMO at 7 dBm Case Ratio to Limit	5 GHz WLAN MIMO Worst Case Ratio to Limit	6 GHz WLAN Ant WiFi 0 Ratio to Limit	6 GHz WLAN Ant WiFi 0 at 6 dBm Case Ratio to Limit	6 GHz WLAN Ant WiFi 0 Worst Case Ratio to Limit	6 GHz WLAN Ant WiFi 1 Ratio to Limit	6 GHz WLAN Ant WiFi 1 at 6 dBm Case Ratio to Limit	6 GHz WLAN Ant WiFi 1 Worst Case Ratio to Limit	6 GHz WLAN MIMO Ratio to Limit	6 GHz WLAN MIMO at 9 dBm Case Ratio to Limit	6 GHz WLAN MIMO Worst Case Ratio to Limit	2.4 GHz Bluetooth Ant WiFi 0 Ratio to Limit	2.4 GHz Bluetooth Ant WiFi 0 at 8.5 dBm Case Ratio to Limit	2.4 GHz Bluetooth Ant WiFi 0 Worst Case Ratio to Limit	2.4 GHz Bluetooth Ant WiFi 1 Ratio to Limit	2.4 GHz Bluetooth Ant WiFi 1 at 8 dBm Case Ratio to Limit	2.4 GHz Bluetooth Ant WiFi 1 Worst Case Ratio to Limit	2.4 GHz Bluetooth Ant WiFi 1 Worst Case Ratio to Limit	
	1a	1b	1c	2a	2b	2d	3a	3b	3d	4a	4b	4c	5a	5b	5d	6a	6b	6c	6d	7a	7b	7c	8a	8b	8c	9a	9b	9c	10a	10b	10c	11a	11b	11c
	Back	0.039	0.011	0.011	0.040	0.019	0.019	0.041	0.026	0.005	0.039	0.039	0.062	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	Top	0.035	0.003	0.003	0.031	0.003	0.003	0.031	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Configuration	2.4 GHz Bluetooth Ant WiFi1 Worst Case + 5 GHz WLAN MIMO Worst Case Ratio to Limit	2.4 GHz Bluetooth Ant WiFi1 Worst Case + 6 GHz WLAN MIMO Worst Case Ratio to Limit	2.4 GHz Bluetooth Ant WiFi1 Worst Case + 5 GHz WLAN MIMO Worst Case Ratio to Limit	2.4 GHz Bluetooth Ant WiFi1 Worst Case + 6 GHz WLAN MIMO Worst Case Ratio to Limit	2.4 GHz Bluetooth Ant WiFi1 Worst Case + 5 GHz WLAN MIMO Worst Case Ratio to Limit	2.4 GHz Bluetooth Ant WiFi1 Worst Case + 6 GHz WLAN MIMO Worst Case Ratio to Limit	2.4 GHz WLAN MIMO Worst Case + 5 GHz WLAN MIMO at 7 dBm Ratio to Limit	2.4 GHz WLAN MIMO Worst Case + 6 GHz WLAN MIMO at 9 dBm Ratio to Limit	2.4 GHz WLAN MIMO Worst Case Ratio to Limit	5 GHz WLAN MIMO Worst Case Ratio to Limit	6 GHz WLAN MIMO Worst Case Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 7 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 9 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 7 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 9 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 7 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 9 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 7 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 9 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 7 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 9 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 7 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 9 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 7 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 9 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 7 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 9 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 7 dBm Ratio to Limit	Worst Case + 2.4 GHz WLAN MIMO at 9 dBm Ratio to Limit	Worst-case Combination Ratio to Limit	Worst-case Combination Ratio to Limit			
	11c+6d	11c+9c	10c+6d	10c+9c	3d+6c	3d+9b	3d	6d	9c	10c+2d+6c	10c+2d+9b	10c+2d																						
	Back	0.557	0.221	0.580	0.244	0.690	0.674	0.526	0.484	0.148	0.579	0.563	0.415																			0.690		
	Top	0.146	0.073	0.200	0.127	0.325	0.225	0.211	0.114	0.041	0.383	0.283	0.269																				0.383	
Configuration	Bottom	0.072	0.039	0.072	0.039	0.105	0.072	0.033	0.072	0.039	0.096	0.063	0.024																			0.105		
	Right	0.704	0.411	0.536	0.243	0.897	0.881	0.638	0.536	0.243	0.826	0.810	0.567																			0.897		
	Left	0.401	0.167	0.599	0.365	0.788	0.732	0.565	0.401	0.167	0.437	0.381	0.214																			0.788		

Notes:

- For all combinations where the sum of WLAN + BT is less than 1, there's no further analysis required for compliance demonstration.
- Values with * were tested at a higher, more conservative power level.
- Configurations labeled as "Worst Case" represent the maximum values between grip sensor inactive and active

FCC ID A3LSMX730	RF EXPOSURE TEST REPORT	Approved by: Technical Manager
DUT Type: Portable Computing Device		APPENDIX E: Page 2 of 3

E.5 Laptop SAR Analysis

Table E-2
Simultaneous Transmission Scenarios for WLAN/BT

Configuration	2.4 GHz WLAN Ant WiFi 0 Ratio to Limit	2.4 GHz WLAN Ant WiFi 0 at 11.5 dBm Ratio to Limit	2.4 GHz WLAN Ant WiFi 0 Worst Case Ratio to Limit	2.4 GHz WLAN Ant WiFi 1 Ratio to Limit	2.4 GHz WLAN MIMO Ratio to Limit	2.4 GHz WLAN MIMO at 14.5 dBm Ratio to Limit	2.4 GHz WLAN MIMO Worst Case Ratio to Limit	5 GHz WLAN Ant WiFi 0 Ratio to Limit	5 GHz WLAN Ant WiFi 0 at 7 dBm Ratio to Limit	5 GHz WLAN Ant WiFi 0 Worst Case Ratio to Limit	5 GHz WLAN Ant WiFi 1 Ratio to Limit	5 GHz WLAN MIMO Ratio to Limit	5 GHz WLAN MIMO at 10 dBm Ratio to Limit	5 GHz WLAN MIMO Worst Case Ratio to Limit	6 GHz WLAN Ant WiFi 0 Ratio to Limit	6 GHz WLAN Ant WiFi 0 at 6 dBm Ratio to Limit	6 GHz WLAN Ant WiFi 0 Worst Case Ratio to Limit	6 GHz WLAN Ant WiFi 1 Ratio to Limit	6 GHz WLAN MIMO Ratio to Limit	6 GHz WLAN MIMO at 9 dBm Ratio to Limit	6 GHz WLAN MIMO Worst Case Ratio to Limit	2.4 GHz Bluetooth Ant WiFi 0 Ratio to Limit	2.4 GHz Bluetooth Ant WiFi 0 at 9.5 dBm Ratio to Limit	2.4 GHz Bluetooth Ant WiFi 0 Worst Case Ratio to Limit	2.4 GHz Bluetooth Ant WiFi 1 Ratio to Limit
	1a	1b	1c	2a	3a	3b	3d	4a	4b	4c	5a	6a	6b	6d	7a	7b	7c	8a	9a	9b	9c	10a	10b	10c	11a
Bottom	0.088	0.261	0.261	0.013	0.094	0.271	0.271	0.125	0.163	0.163	0.016	0.148	0.166	0.166	0.031	0.058	0.058	0.011	0.038	0.079	0.079	0.054	0.081	0.081	0.000
Configuration	2.4 GHz Bluetooth Ant WiFi 1 + 5 GHz WLAN MIMO Worst Case Ratio to Limit		2.4 GHz Bluetooth Ant WiFi 1 + 6 GHz WLAN MIMO Worst Case Ratio to Limit		2.4 GHz Bluetooth Ant WiFi 0 Worst Case + 5 GHz WLAN MIMO Worst Case Ratio to Limit		2.4 GHz Bluetooth Ant WiFi 0 Worst Case + 6 GHz WLAN MIMO Worst Case Ratio to Limit		2.4 GHz WLAN MIMO Worst Case + 5 GHz WLAN MIMO Worst Case Ratio to Limit		2.4 GHz WLAN MIMO Worst Case + 6 GHz WLAN MIMO Worst Case Ratio to Limit		2.4 GHz WLAN MIMO Worst Case Ratio to Limit		5 GHz WLAN MIMO Worst Case Ratio to Limit		6 GHz WLAN MIMO Worst Case Ratio to Limit		2.4 GHz Bluetooth Ant WiFi 0 + 2.4 GHz WLAN Ant WiFi 1 + 5 GHz WLAN MIMO Worst Case Ratio to Limit		2.4 GHz Bluetooth Ant WiFi 0 + 2.4 GHz WLAN Ant WiFi 1 + 6 GHz WLAN MIMO Worst Case Ratio to Limit		2.4 GHz Bluetooth Ant WiFi 0 + 2.4 GHz WLAN Ant WiFi 1 Ratio to Limit		WLAN/BT Worst-case Combination Ratio to Limit
	11a+6d		11a+9c		10c+6d		10c+9c		3d+6d		3d+9c		3d		6d		9c		10a+2a+6d		10a+2a+9c		10a+2a		
	0.166		0.079		0.247		0.160		0.437		0.350		0.271		0.166		0.079		0.233		0.146		0.067		

Notes:

- For all combinations where the sum of WLAN + BT is less than 1.6, there's no further analysis required for compliance demonstration.
- Configurations labeled as "Worst Case" represent the maximum values between grip sensor inactive and active

E.6 Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D04v01 and IEEE 1528-2013 Section 6.3.4.1.2.

FCC ID A3LSMX730	RF EXPOSURE TEST REPORT	Approved by: Technical Manager
DUT Type: Portable Computing Device		APPENDIX E: Page 3 of 3